# TITLE

# PLEATED AND CELLULAR MATERIALS

## CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation in part of United States Patent Application Serial No. 08/756,282 filed November 25, 1996, which is a continuation of United States Patent Application Serial No. 08/412,875, filed March 29, 1995, and issued as United States Patent No. 5,630,898 on May 20, 1997.

## BACKGROUND OF THE INVENTION

### Field of the Invention

This invention relates to a tabbed and pleated cellular material and method for the manufacture thereof and more particularly to a window covering which contains this tabbed and pleated cellular material.

### Description of the Prior Art

There are two basic types of folded window coverings. A first pleated type consists of a single layer of corrugated material. The other is a more complex cellular type where pleated layers are joined or folded strips are stacked to form a series of collapsible cells. This latter type is known to have favorable thermal insulation properties because of the static air mass which is trapped between the layers of material when the cells are in the expanded position. The single-layer type, on the other hand, is favored for its appearance in some cases, and is less expensive to manufacture. There is also a tabbed single layer of corrugated material which is disclosed in my United States Patent No. 4,974,656. The tabbed single layer of pleated material

has been sold in window coverings and been commercially successful. Consequently, there is a market for a window shade made with a tabbed cellular material.

There are two basic approaches to making cellular products and tabbed panels from a roll of fabric material. The first method pleats or bonds the material transverse to the length of the roll and the second method pleats or bonds longitudinally along its length.

The output of the transverse method cannot be wider than the roll width of the original material. The longitudinal method is limited in the types of patterns that can be printed on the material because alignment is random. The transverse methods have been limited to a single layer, a single tabbed layer or a triple layer where there are three continuous surfaces that create a panel of double cells.

There is a need to have a transverse process that can make a panel of single cells. There is also a need to increase the speed of production output of single, double and triple layers.

There are several methods of producing the cellular shades. Most similar to the pleated, single-panel method is Anderson U.S. Patent No. 4,685,986. This method joins together two single-panel pleated lengths of material by adhesively bonding them together at opposing pleats. Other methods depart from this Anderson patent by joining together a series of longitudinally folded strips, rather than continuous sheets of pleated material. Such methods are shown in Colson U.S. Patent No. 4,450,027, and in Anderson U.S. Patent No. 4,676,855. In the Colson patent, strips of fabric are longitudinally folded into a U-shape and adhered on top of one another, whereas in the Anderson patent these strips are Z-shaped and are adhered in an interlocking position.

In United States Patent No. 5,043,038 Colson discloses a method of cutting a honeycomb structure longitudinally to divide them into two tabbed single layer pleated panels.

That honeycomb structure was formed from U-shaped strips as taught in Colson's United States Patent No. 4,450,027 by a process of winding the foldable material around a base apparatus, applying glue to one face of the material and adhering each layer to the adjacent layer. This method tends to cause the tab to wrinkle because the stack is wrapped on a slightly curved mandrel. Also, because the material layers are wound in a stack, the length of the panels of final product are limited to the height of the wrapped stack and the ends of the stack are wasted.

Another method for making cellular shades is disclosed in United States Patents 5,015,317; 5,106,444 and 5,193,601 to Corey et al. In that process fabric material is run through a production line that first screen prints the fabric and then applies thermoplastic glue lines at selected intervals. The fabric is then pleated, stacked, and placed in an oven to both set the pleats and bond the material at the glue lines.

There is a need for a method to utilize the current transverse processing equipment technology to make a larger variety of single and multi-layer panels at a faster rate.

## SUMMARY OF THE INVENTION

The present method overcomes the problems and achieves the objectives indicated above by providing a method of manufacturing a pleated shade or a honeycomb structure by a means of splitting honeycomb or multicellular material into two or more tabbed, pleated panels or tabbed, cellular panels.

According to the teachings of the present invention, a stack of folded fabric is bonded to form a honeycomb structure having a series of cells connected together along bond lines. An interface region is present between adjacent cells which forms the bridge between horizontally adjacent stacks of cells. At least one bond line applied between adjacent fabric

walls defines each interface region. These interface regions are split to form separate tabbed, pleated panels or separate panels of cells having tabs on one face between each pair of pleats. These tabs extending between each pleated panel or between individual cells, as the case may be, extend at least 1/16" in length. To simplify handling and to create a uniform appearance the tabs are identical in size resulting from a straight-line split along a distinct perpendicular plane, but the invention is not limited to this.

The tabbed cellular material is attached between a headrail and a bottomrail to form a window covering. Lift cords are routed from the bottomrail, through the cellular material and through the headrail for raising and lowering the window covering.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1 and 2 are diagrams showing how the honeycomb stack is formed.

Figure 3 is a diagram showing a triple cell honeycomb stack being split into two tabbed honeycomb panels according to the teachings of the present invention.

Figure 4 is a diagram showing a double cell honeycomb stack being split into tabbed panels.

Figure 5 is a diagram of a five cell honeycomb stack being split into two double honeycomb panels having tabs which are formed on one face of both panels.

Figure 6 is a side view of a window covering made from tabbed, single cell material.

Figure 7 is a side view of similar to Figure 6 showing the lower portion of a window covering made from prismatic or D-shaped, tabbed, single cell material.

Figure 8 is a side sectional view of another D-shaped, tabbed, single cell material.

Figure 9 is a side sectional view of two tabbed cells showing attachment of adjacent cells by a single strip of adhesive.

Figure 10 is a side sectional view of two tabbed cells showing attachment of adjacent cells by several lines or beads of adhesive and a preferred location of a lift cord shown in dotted line.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figures 1 and 2, I provide a sheet of pleated fabric 2 which is folded on work surface 1 to form a fabric stack 10. Pleated fabric 2 is delivered to the work surface by a sprocket or other feed mechanism 12 which draws the fabric from a source of supply which is not shown. Glue applicators 14 and 16 apply bond lines 18 of hot melt glue on a surface 4 of the fabric. When the fabric is in the position shown in Figure 1 surface 4 is facing upward. After the fabric has been laid from right to left across the length of stack 10, the fabric is folded as shown in Figure 2. The movement of the stack relative to the fabric being supplied folds the fabric 2 back over the stack forming a pleat 8. Now surface 4 is facing down and opposite surface 6 is facing up. In that position glue applicator 16 applies lines of glue on surface 6. The fabric is laid across the stack from left to right. The process is repeated until a complete stack of fabric 10 has been created. That stack will then have sets of bond lines in vertical planes transverse to the pleat faces. Then, the stack is placed in an oven to melt the glue and bond the pairs of opposing faces together. If desired, irons could be provided to press the pleats after a selected number of passes. Although I prefer to create bond lines using an adhesive, particularly a hot melt adhesive, it is also possible to create the bond lines using a heat welder. After each pair of

opposed pleat faces is laid they are welded together. I have found that a heat welder will bond two overlying sheets without affecting a third sheet below the sheets which are bonded.

In Figures 1 and 2 I show the adhesive lines being applied to pleated fabric. If desired, one can apply the adhesive to the fabric first and then pleat the fabric.

Referring now to Figure 3, a splitter 20 is positioned above the stack so that blades 21 and 23 are positioned directly above adjacent glue lines 18a and 18b. Splitter 20 is then moved through the stack thereby cutting the stack along the glue lines. These cuts form two single cell honeycomb panels 24 and 26. Preferably, the knife cuts between two planes of glue lines A and B so that after cutting the set of glue lines 18a in plane A are in one panel 24 and the set of glue lines 18b in plane B are in a second panel 26. Alternatively, the knife could cut through a plane of glue lines so that a portion of each glue line is in each panel. Each cell 30 has four primary side walls 31, 32, 33 and 34 and two parallel walls to which adjacent cells are attached forming a six-sided polygon shown in Figure 3. Because of the method of manufacture a tab 28 has been formed between adjacent pleat faces or cell sidewalls 32 and 33 and contrast opposite side walls 33 and 34 meet to form a standard pleat, fold or crease. Adjacent cells are connected together by glue lines 18c and 18d at attachment zones, or interconnection zones as shown by Figure 3. I prefer to provide a standard pleat face of 1/2" with a 1/4" bridge formed by glue lines 18c and 18d. Preferably the tab has a width of 1/16" creating an overall width of 1 5/16". The region between glue lines 18 and 18b is preferably 1/8". Thus, the width of stack 10 would be 2 3/4" to make two panels of this preferred fabric size. Other standard sizes of pleat faces ranging from 1/4" to about 1" can easily be made with this process. Indeed, the pleats can be any desired size.

I prefer that cutter 20 have two outside knives 21 and 23 and one inside knife as shown in Figure 3. The use of two outside knives allows for a better cutting of the glue lines and for a greater tolerance for error of a glue plane placement and thickness. The center knife cuts the accordion pleat remnant in half so that the resulting smaller strips can easily be drawn off by vacuum.

Figure 4 shows a double cell honeycomb stack 30 being split. The cells are formed by sets of glue lines 18a and 18b in planes A and B. The double cells are split by knives 21 and 23 along a perpendicular plane through the glue lines. This method forms two panels of pleated material 32 and 34 each having a joint tab 28 on one face between each pair of adjacent pleat faces 36 and 38. The joint tabs 28 extending between each pair of pleats preferably should measure at least 1/16" in length.

Figure 5 is a diagram of a five-cell honeycomb stack 40 being split. The five-cell honeycomb stack is split along a cutting plane parallel to the planes A and B containing glue lines 18a and 18b. This method forms two panels 42 and 44 of double cell honeycomb material having tabs 28 on one face. The splitter shown in Figure 5, generally designated as 20, is comprised of a center blade 22 which pierces the stack 40 and two blades 21 and 23 that cut the interior edge of each alternating adhesive bond lines 18a and 18b.

Although I have shown the tabs being formed from a single glue line, tab 28 may be formed by either means of a single or a double bond or line of adhesive sometimes called an adhesive strip or glue bead depending upon how the glue is applied. The joint tabs in the separated panels in the figures are the same size. However, this is not necessary. Also, I have shown the glue lines extending to the ends of the tabs. But, this is not necessary.

A major advantage of the present method over the prior art is the gluing machine can make two, tabbed, pleated layers; two, tabbed, single-cells; or two tabbed, double-cell layers by changing the pump pressure and the orifice configuration on the glue heads. Such a change can be made in less than hour. Since the splitter is much faster and simpler than the gluing process, it is a less expensive machine and can handle the output of 3 or 4 gluing machines.

The stack of the present invention can be formed on several types of prior art pleating machines modified to have glue heads and to fold the fabric into the stack after gluing, or by simply modifying the glue heads on machines which have them to place more glue lines at different intervals. Such modified machines should be able to put out nearly twice the effective output than they did prior to modification.

As shown in Figure 6, a tabbed, cellular panel 26 is attached between a headrail 50 and bottomrail 52. The uppermost cell is attached to the headrail. An insert or slat 56 fits through the lowermost cell and that assembly is attached to the main housing 57 of the bottomrail 52. Lift cords or pullcords 51 extend from the bottomrail 52, also called the lower rail assembly through the cellular material 26 and into the headrail 50, also called the upper rail assembly. The lift cords may pass through a cord lock 53 and the front face of the headrail as shown or may be attached to a tube lift (not shown). Typically, at least two lift cords are used for each window covering. Each lift cord 51 passes through the centerline of the cells with the glue lines 76 being approximately equidistant from that centerline. The glue lines extend the full width of the cellular material and define the front and rear limits or edges of the interconnection zones or the middle sides of the six-sided cells. Adjacent cells may be attached by a single strip of adhesive 76 as shown in Figure 9 or by several glue lines 76 as shown in Figure 10. I prefer to provide at least two spaced apart glue lines forming at least two spaced apart attachment zones so

that the lift cord may pass through holes cut between them as shown in Figures 6 and 10. With that arrangement drilling the cord holes is much easier. The hollow drill bit is less likely to become clogged and the glue lines act as guides to direct the drill bit through the fabric between them.

The cells may be symmetrical like those shown in Figure 6 or nonsymmetrical. In the embodiment shown in Figure 7, the cells have a prismatic shape or D-shape. The interior angle defined between the front upper side 33 and the front lower side 34 is less than the interior angle between the rear upper side 32 and the rear lower side 31. In the symmetrical cells shown in Figure 6, these angles are approximately equal. The symmetrical cells in Figure 6 are connected so that a centerline through interconnection zone 54 will be collinear with a centerline through the cells. However, in the cell shapes of Figures 7 and 8, a centerline through the interconnection zone is rearward or forward of a centerline through the cells. The centerline through the cells is indicated by dotted line A-A in Figures 7 and 8. In all of the cellular structures shown in the drawings, the interconnection zones in each cellular panel are parallel to one another and equal in length. Consequently, the panel will have a uniform appearance from top to bottom when hung.

A variety of fabrics could be used to make the cellular structure. However, the industry has tended to use less expensive, non-woven fabrics made from synthetic materials, particularly polyester fabrics. Those skilled in the art will also recognize that several different adhesives could be used. One suitable adhesive is moisture cured cross-linking polyurethane adhesive. One could also use a hot-melt thermoplastic polyester UV-stabilized adhesive.

Even though I prefer to make the tabbed cellular structure in the manner illustrated and described here, other techniques could be used. Sonic welding could be used

rather than adhesives. The stack could be constructed and cut to create only one cellular structure and fabric pieces rather than two panels of fabric. Strips of a hot melt glue could be applied to the fabric before the fabric is folded to form the stack.

Although I have shown certain present preferred embodiments of my method and the pleated and honeycomb structures made therefrom, it should be distinctly understood that my invention is not limited thereto, but may be variously embodied within the scope of the following claims.